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2: More types, Methods, Conditionals

Outline

- Lecture 1 Review
- More types
- Methods
- Conditionals

Types

Kinds of values that can be stored and manipulated.

boolean: Truth value (**true** or **false**).

int: Integer (0, 1, -47).

double: Real number (3.14, 1.0, -2.1).

String: Text (“hello”, “example”).

Variables

Named location that stores a value

Example:

```
String a = "a";
String b = "letter b";
a = "letter a";
String c = a + " and " + b;
```

Operators

Symbols that perform simple computations

- Assignment: =
- Addition: +
- Subtraction: -
- Multiplication: *
- Division: /

Exercise 1

```
class GravityCalculator {
 public static void main(String[] args) {
    double gravity = -9.81;
    double initialVelocity = 0.0;
    double fallingTime = 10.0;
    double initialPosition = 0.0;
    double finalPosition = .5 * gravity * fallingTime *
                           fallingTime;
    finalPosition = finalPosition +
                    initialVelocity * fallingTime;
    finalPosition = finalPosition + initialPosition;
    System.out.println("An object's position after " +
    fallingTime + " seconds is " +
     finalPosition + " m.");
      }
}
```

Exercise 1

```
double finalPosition = .5 * gravity * fallingTime *
                                                fallingTime;
finalPosition = finalPosition + initialVelocity
                                        * fallingTime;
finalPosition = finalPosition + initialPosition;
```

OR

```
double finalPosition = .5 * gravity * fallingTime *
                                                fallingTime;
finalPosition = finalPosition + initialVelocity
                                        * fallingTime;
finalPosition += initialPosition;
```

Questions from last lecture?

Outline

- Lecture 1 Review
- More types
- Methods
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Division

Division ("/") operates differently on integers and on doubles!

Example:

```
double a = 5.0/2.0; // a =2.5
int b = 4/2;  // b = 2
int c = 5/2;  // c = 2
double d = 5/2;  // d= 2.0
```

Order of Operations

Precedence like math, left to right

Right hand side of = evaluated first

Parenthesis increase precedence

```
double x = 3 / 2 + 1; // x = 2.0
double y = 3 / (2 + 1); // y = 1.0
```

Mismatched Types

Java verifies that types always match

```
String five = 5; // ERROR!
```

```
./Root/Main.java:8: error: incompatible types: int cannot be converted to String
        String five = 5;
                      ^
1 error
```

Conversion by casting

What is a casting?

- Taking an Object of one particular type and "turning it into" another Object type.

```
int a = 2;                      // a = 2
double a = 2;                   // a = 2.0 Implicit

int a = 18.7;                   // ERROR
int a = (int)18,7:              // a = 18

double a = 2/3;                 // a = 0.0
double a = (double)2/3;         // a = 0.666 ...

double d = 5.25;
int i = (int) d;                // d = 5 (Explicit) DOWNCAST

int d = 5;
double i = d;                   // i = 5.0 (Implicit) UPCAST
```

Outline

- Lecture 1 Review
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- **Methods**
- Conditionals

Java Methods

- A collection of statements that are grouped together to perform an operation.
  - System.out.println()→
    - The system actually executes several statements in order to display a message on the console.
- The only required elements of a method declaration are the method's return type, name, a pair of parentheses, (), and a body between braces, {}.

Parts

```
class Main {
  public static void main(String[] arguments)
  {
    System.out.println("Hello World");
  }
```

Methods

Method declarations have six components:

- Modifiers.
- The return type (or void).
- The method name.
- The parameter list in parenthesis.
- An exception list.
- The method body, enclosed between braces.

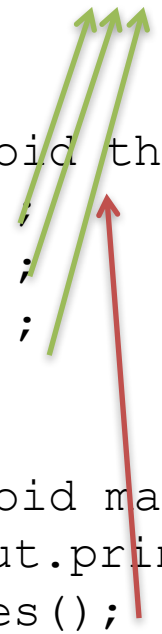
```
class Main {
  public static void main(String[] arguments)
  {
     System.out.println("Hello World");
  }
```

Adding Methods

```
public static void NAME() {
   STATEMENTS
}

To call a method:

NAME();
```

Methods

```
class NewLine {
        public static void newLine() {
                System.out.println("");
        }

        public static void threeLines() {
                newLine();
                newLine();
                newLine();
        }

        public static void main(String[] arguments) {
                System.out.println("Line 1");
                threeLines();
                System.out.println("Line 2");
        }
}
```



Parameters

```
public static void NAME(TYPE NAME) {
   STATEMENTS
}

To call:

NAME(EXPRESSION);
```

Parameters

```
class Square {
	public static void printSquare(int x) {
		System.out.println(x*x);
	}

	public static void main(String[] arguments) {
		int value = 2;
		printSquare(value);
		printSquare(3);
		printSquare(value*2);
	}
}
```

Parameters

What's wrong here?

```
class Square {
      public static void printSquare(int x) {
            System.out.println(x*x);
      }

      public static void main(String[] arguments) {
            printSquare(”hello”);
            printSquare(5.5);
      }
}
```

Parameters

What's wrong here?

```
class Square {
	public static void printSquare(double x) {
		System.out.println(x*x);
	}

	public static void main(String[] arguments) {
		printSquare(5);
	}
}
```

Multiple Parameters

```
[…] NAME(TYPE NAME, TYPE NAME) {
    STATEMENTS
}
```

To call:

```
NAME(arg1, arg2);
```

Multiple Parameters

```
class Multiply {
	public static void times (double a, double b) {
		System.out.println(a * b);
	}

	public static void main(String[] arguments) {
		times (2, 2);
		times (3, 4);
	}
}
```

Return Values

```
public static TYPE NAME() {
   STATEMENTS
   return EXPRESSION;
}
```

`void` means "no returned value"

Return Values

```
class Square3 {
	public static void printSquare(double x) {
		System.out.println(x*x);
	}
	public static void main(String[] arguments) {
		printSquare(5);
	}
}
```

```
class Square4 {
	public static double square(double x) {
		return x*x;
	}
	public static void main(String[] arguments){
		System.out.println(square(5));
		System.out.println(square(2));
	}
}
```

Variable Scope

Variables live in the block ({}) where they are defined (**scope**)

- Scope starts where the variable is declared
- … and ends whith the block where it was declared
- (the variable lives within the block)

Method parameters are like defining a new variable in the method

Variable Scope

```
class SquareChange {
  public static void printSquare(int x) {
      System.out.println("printSquare x = " + x);
      x = x * x;
      System.out.println("printSquare x = " + x);
  }

  public static void main(String[] arguments) {
      int x = 5;
      System.out.println("main x = " + x);
      printSquare(x);
      System.out.println("main x = " + x);
  }
}
```

Variables Scope

```
class Scope {
  public static void main(String[] arguments) {
       int x = 5;
       if (x == 5) {
            int x = 6;
            int y = 72;
            System.out.println("x = " + x + "
                  y = " + y);
       }
  }
  System.out.println("x = " + x + " y = " + y);
}
```

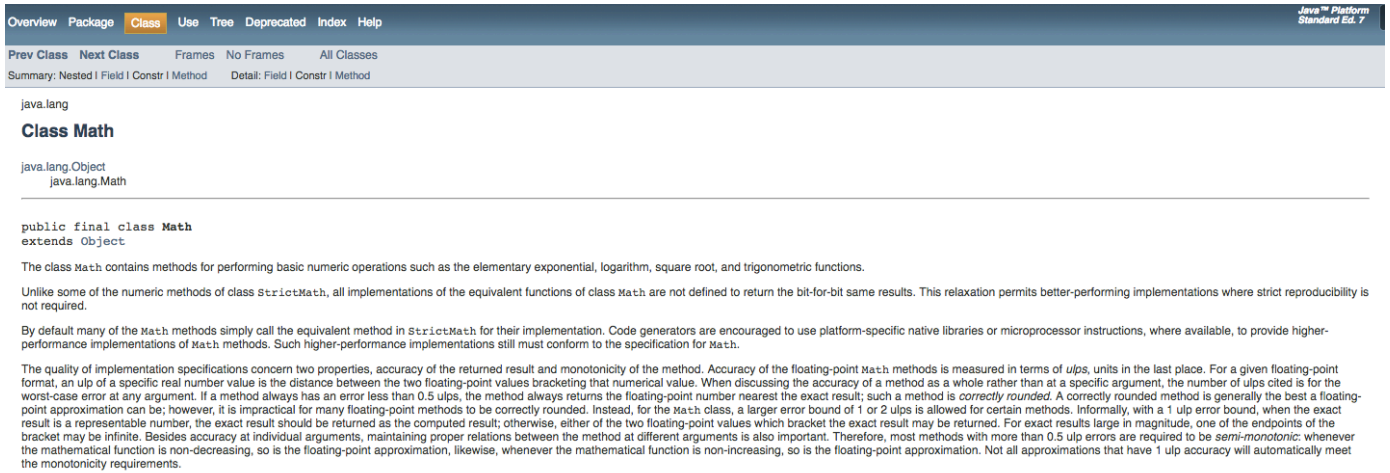
Methods: Building Blocks

Methods as the way of encapsulating functionality

- Big programs are built out of small methods
- Methods can be individually developed, tested and reused
- User of method does not need to know how it works
  - Black box operations
- In Computer Science, this is called "abstraction"

Mathematical Functions

Encapsulated functionality that we can use without having to master inner details



Overview Package Class Use Tree Deprecated Index Help — Java™ Platform Standard Ed. 7

Prev Class Next Class Frames No Frames All Classes

Summary: Nested | Field | Constr | Method Detail: Field | Constr | Method

java.lang

Class Math

java.lang.Object
  java.lang.Math

```
public final class Math
extends Object
```

The class `Math` contains methods for performing basic numeric operations such as the elementary exponential, logarithm, square root, and trigonometric functions.

Unlike some of the numeric methods of class `StrictMath`, all implementations of the equivalent functions of class `Math` are not defined to return the bit-for-bit same results. This relaxation permits better-performing implementations where strict reproducibility is not required.

By default many of the `Math` methods simply call the equivalent method in `StrictMath` for their implementation. Code generators are encouraged to use platform-specific native libraries or microprocessor instructions, where available, to provide higher-performance implementations of `Math` methods. Such higher-performance implementations still must conform to the specification for `Math`.

The quality of implementation specifications concern two properties, accuracy of the returned result and monotonicity of the method. Accuracy of the floating-point `Math` methods is measured in terms of *ulps*, units in the last place. For a given floating-point format, an ulp of a specific real number value is the distance between the two floating-point values bracketing that numerical value. When discussing the accuracy of a method as a whole rather than at a specific argument, the number of ulps cited is for the worst-case error at any argument. If a method always has an error less than 0.5 ulps, the method always returns the floating-point number nearest the exact result; such a method is *correctly rounded*. A correctly rounded method is generally the best a floating-point approximation can be; however, it is impractical for many floating-point methods to be correctly rounded. Instead, for the `Math` class, a larger error bound of 1 or 2 ulps is allowed for certain methods. Informally, with a 1 ulp error bound, when the exact result is a representable number, the exact result should be returned as the computed result; otherwise, either of the two floating-point values which bracket the exact result may be returned. For exact results large in magnitude, one of the endpoints of the bracket may be infinite. Besides accuracy at individual arguments, maintaining proper relations between the method at different arguments is also important. Therefore, most methods with more than 0.5 ulp errors are required to be *semi-monotonic*: whenever the mathematical function is non-decreasing, so is the floating-point approximation, likewise, whenever the mathematical function is non-increasing, so is the floating-point approximation. Not all approximations that have 1 ulp accuracy will automatically meet the monotonicity requirements.

```
public class Main {
  public static void main(String[] arguments) {
       int x = 90;
       Math.sin(x);
       Math.cos(Math.PI / 2);
       Math.pow(2, 3);
       System.out.println(...);}
  }
}
```

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if statement

```
if (CONDITION) {
   STATEMENTS
   /* statements performed
   when the boolean expression
   results true */
}
```

if statement

```
public static void test(int x) {
     if (x > 5) {
        System.out.println(x + " is > 5");
     }
}

public static void main(String[] arguments) {
     test(6);
     test(5);
     test(4);
}
```

Comparison operators

```
x > y: x is greater than y
x < y: x is less than y
x >= y: x is greater than or equal to x
x <= y: x is less than or equal to y

x == y: x equals y
  ( equality: ==, assignment: = )
```

Boolean operators

```
&&: logical AND
||: logical OR
```

```
if (x > 6) {
  if (x < 9) {
    …
  }
}
```

```
if ( x > 6 && x < 9) {
  …
}
```

else

```
if (CONDITION) {
   STATEMENTS
} else {
   STATEMENTS
   /* performed when CONDITION is
   not true */
}
```

else

```
public static void test(int x) {
   if (x > 5) {
      System.out.println(x + " is > 5");
   } else {
      System.out.println(x + " is not > 5");
   }
}

public static void main(String[] arguments) {
   test(6);
   test(5);
   test(4);
}
```

else if

```
if (CONDITION) {
   STATEMENTS
} else if (CONDITION) {
   STATEMENTS
} else if (CONDITION) {
   STATEMENTS
} else {
   STATEMENTS
}
```

else

```
public static void test(int x) {
   if (x > 5) {
      System.out.println(x + " is > 5");
   } else if (x == 5) {
      System.out.println(x + " equals 5");
   } else {
      System.out.println(x + " is < 5");
   }
}

public static void main(String[] arguments) {
   test(6);
   test(5);
   test(4);
}
```

Questions?